ON THE DISTRIBUTION FUNCTION OF PARTICLES AT QUASI-PARALLEL COLLISIONLESS SHOCKS

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The departure of particle distributions from the Maxwellian is commonly observed in space plasmas. These non-Maxwellian distributions which are typical for plasmas that are not in thermal equilibrium, can be modeled with Kappa distribution function. Kinetic simulations of quasi-parallel collisionless shocks show that proton distribution is a composite of thermal, supra-thermal, and non-thermal parts, which correspond to thermalized, pre-accelerated, and diffusive-shock-accelerated protons, respectively. By using particle-in-cell shock simulations, we show that Kappa distribution adequately fits thermal and supra-thermal parts together, as one continuous distribution in early proton spectra. We find that the index κ of the distribution increases over time, following the decrease in supra-thermal part. At later times, initially strong supra-thermal part almost completely fades, leaving the proton distribution composed of a Maxwellian and a power-law.